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AN

ORATION,

ON

CHEMISTRY AND BOTANY;

DELIVERED BEFORE THE

Phi Beta Kappa Society,

AT NEW HAVEN,

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AN ORATION.

GENTLEMEN,

IT was for the laudable purpose of exciting a spirit of emulation and enquiry, among the members of this society, that an annual oration was instituted.

The task of addressing you, which has devolved on me, I come to fulfil, by making a few observations upon natural philosophy. I shall confine my observations to chemistry and botany, parts of natural science which have indeed been too much neglected by the learned in this state, although they have been pursued, with great industry, by the philosophers of Europe.

No apology is necessary for addressing this society upon the science of chemistry; since this science, is made a part of academic education in most of the universities of Europe; and since a great part of the learning of Europe, is employed in the advancement of this science.

Chemistry treats of the properties of all material substances, and the changes of those properties in different circumstances; as it is the science of the effects of heat and affinity upon all bodies.

No part of natural science promises greater utility to

man, whether it is conſidered as a pleaſing employment for the mind, as immediately applicable to every economic art, to the ſcience of medicine, or to the explanation of the phenomena of nature.

In exhibiting a few of the principles and improvements of chemiſtry, it is not my object to build it upon the ruins of any other ſcience. All the ſciences are mutually dependent and connected, by a common bond. There is but one great ſyſtem of mind and matter; but one great firſt cauſe, who has formed this ſyſtem, and who regulates it by his uniform providence; or rather whoſe providence is this ſyſtem. To underſtand this ſyſtem, the knowledge of its parts are eſſentially neceſſary. The ſcience of chemiſtry, as an important part of this ſyſtem, particularly claims our attention. Chemiſtry was introduced into Europe by the conqueſt of the Arabians. From avarice and a fondneſs for myſtery, which was peculiar to the dark ages, it received ſome ſlow and obſcure improvements. Of this period it is ſufficient to obſerve, that the ignorance, ſuperſtition and credulity of the Europeans, influenced them in philoſophy as well as in politics and religion. The ſame extravagant ſpirit, which rouſed all Europe in defence of an empty ſepulchre, afterwards manifeſted itſelf in the purſuit of the alkaheſt, the philoſophers ſtone, the tranſmutation of the baſer metals into ſilver and gold, and an univerſal medicine. The remains of the ſame ſpirit are now exhibited in our newſpapers and apothecaries ſhops, under the title of *ſovereign remedies*, *infalible balsoms*, *balms af Gillead*, and a long liſt of patent medicines, which promiſe eternal youth and vigor to their purchaſers.

The hiſtory* of the origin of chemiſtry, is uſeful on-

* For the history of chemistry, see Boerhaave's chemistry.

ly to prove how ſlow, laborious and uncertain, is the advancement of the human underſtanding, unleſs aided by the correct reſults of obſervation and an unprejudiced love of truth. Chemiſtry remained a mere collection of facts, until the laſt century. It then received great improvements from the philoſophical experiments of Boyle, Hales, Scheele, Ingenhouze, Bergman, Prieſtley, Black, Watſon, and many others. But to the united exertions of Morveau, Berthollet, Fourcroy, Chaptal and Lavoiſier, the world is indebted for the preſent ſyſtem of chemiſtry—A ſyſtem which is not inferior to that of Newton, in the ſimplicity and demonſtrability of its firſt principles, or the uniform application of thoſe principles, to the explanation of the phenomena of nature. The nomenclature of this ſyſtem, beautifully exhibits the connection, which exiſts between language and logic. To ſimple ſubſtances arbitrary names are given, to compound ſubſtances are given names ſignificant of the parts of the compoſition and modes of combination. The inventors of the new ſyſtem, in every inſtance, ſubmitted their reaſonings to the teſt of experiment, and never ſearched for truth, but by the natural road of experiment and obſervation; as mathematicians obtain the ſolution of a problem, by the mere arrangement of data, and by reducing their reaſoning to ſuch ſimple ſteps, and to concluſions ſo very obvious, as never to loſe ſight of the evidence by which they are guided.

Many are the diſcoveries of chemiſtry, both in the ſublime and uſeful parts of philoſophy. It teaches us a new principle of attraction, the attraction of affinity*.

* Affinity, or elective attraction, is a tendency which bodies have to unite and form a third ſubstance, whoſe ſensible properties are unlike either body. Sir Isaac Newton formed the firſt table of affinities; which is now to the chemiſt what the logarithmic tables are to the navigator.

The laws of affinity, though more numerous and complicated, are not leſs uniform in their opperations, than the laws of gravitation. In addition to all thoſe parts of matter, which are ſubjected to the laws of gravitation, to the laws of affinity, are ſubjected light and calocie. The exiſtence of all the ſolid and fluid bodies in nature, which are not elementary ſubſtances, depends upon the principles of affinity; without which, the world would be as in the creation, without form and void. By the knowledge of the laws of affinity, we decompoſe bodies, and of their conſtituent elementary parts, produce a new creation. From analyſis it is demonſtrated, that atmoſpheric air conſiſts of the ſame elements, as that powerful fluid formerly called aqua fortis. The difference of the ſenſible properties of thoſe two ſubſtances, depends entirely upon the different ſtate of affinity.

Aſtronomy, aud the higher branches of the mathematics, are made a part of education, not on account of their being applicable to the purpoſes of life, but becauſe by their ſtudy is acquired an accurate method of thinking. Like the mathematics, chemiſtry teaches an accurate mode of reaſoning, and from the extenſive views of the laws of nature expand the mind.

Among the diſcoveries of modern chemiſtry, none is more important, or leads to more intereſting facts, than that of the compoſition of our atmoſphere. Long had it eluded the reſearch of philoſophers, until the preſent analytic mode of reaſoning was introduced into chemiſtry. This diſcovery was made after a ſeries of accurate experiments, by the unfortunate Lavoiſier. Previous to the diſcovery of the atmoſpheric air, was that of pure air, which was made almoſt at the ſame time by Lavoſier, Prieſtley and Scheele. To theſe ſucceeded the diſcoveries of the compoſition of water, of the opperations

of combuſtion, of the baſes of the acids, of vegetation and of animation, ſo far as it depends upon reſpiration.

No ſooner were the properties, and modes of combination of pure air known, than the principles of the oxygenation of the blood were eſtabliſhed. It is now aſcertained that life is literally a flame, ſupported by a ſlow combuſtion of our atmoſphere. The diſcoveries of the compoſition of our atmoſphere, and the effects of different airs upon the human conſtitution, have rouſed the attention of philoſophers, in every part of the world. Davis, Girtanner and Beddoes*, with rapid ſtrides through the path of ſcience, have promiſed to open a new æra, and expel diſeaſe from man. There are enthuſiaſts and fanatics, among philoſophers, as well as among ſectaries. A ſcience may be as much degraded by aſſuming fanciful theories, as by the effects of ignorance. The German philoſophers, who formerly pretended to explain the cauſe of a phenomenon, without having previouſly aſcertained its exiſtence, were no leſs ridiculous, than ſome new theoriſts, who have attempted to ſolve certain problems, by words† which have no definite ideas annexed to them, and by principles utterly inapplicable. Falſe theory is not peculiar to chemiſtry, it is to be found in every department of ſcience. The prediction of Newton, when he obſerved, "if the particles of air, ſhould come in contact, they would be converted into marble," has been verified, by the diſcoveries of modern chemiſtry. Our atmoſphere is indeed the reſervoir of the elementary particles of all bodies. And marble is but a compoſition of fixed air, or carbone and lime, which is

* Honor is due to these philosophers, for several important discoveries, both in medicine and chemiſtry.

† How many new theories have been formed and how many old ones said to be destroyed by the word electricity?

probably a compoſite body. By analyſis and ſyntheſis, are ſhewn the converſion of airs into plants, plants into animal matter, and animal matter into plants, and the original elements. Vegetable analyſis conſtantly exhibits three elements. Two of them, the component parts of water, oxygen and hydrogen, and thoſe two a ſolvent for the third, which is carbone. In exhibiting the phenomena of the life of plants, and the mechaniſm of their compounds, is ſhewn that vegetable life, is merely a ſucceſſion of chemical powers and attractions. Such a ſeries of facts, founded upon the moſt correct experiments, explaining the nutrition of plants, will eſtabliſh a rational ſyſtem of agriculture, and lead to important improvements in that moſt uſeful art.

The different airs are only a modification of ſolid matter, combined with caloric, and according to their different affinities, are capable of aſſuming a concrete form, and being united to the moſt fixed bodies in nature.

The diſcovery of the properties of airs, was followed, by that of the beautiful proceſs in nature, the purification of the atmoſphere, by means of the reſpiration of plants. All parts of creation mutually labor, for the ſupport and perfection of each other. Whatever element is rejected from the laboratory of one organized body, becomes the food of another part of creation. It was diſcovered by Dr. Prieſtly, and ſince ſupported, by the experiments of Count Rumford, that plants conſtantly emit pure air; but from a ſeries of accurate experiments, Profeſſor Woodhouſe has proved, that plants emit pure only when ſupplied with fixed air.

The moſt ſurpriſing effects, to be reckoned among the laws of nature, are produced by chemical ſubſtances. Among which are the fulminating gold, ſilver and mercu-

ry, the ſpontaneous combuſtion of phoſphorus and pyrophorus, at the common temperature of the atmoſphere, and the hyper-oxygenated muriate of potaſh. Three grains of the latter ſubſtance, by tritenation, produce an exploſion truly aſtoniſhing. By the union of two cold fluids, is produced a rapid and inſtantaneous combuſtion, almoſt inextinguiſhable. By the combuſtion of two ſimple airs, hydrogen and oxygen is produced a bright flame, and a heat ſufficient to melt platina. The formation of meteors, and the ſpontaneous combuſtions, which cauſe volcanic eruptions, are imitated and explained by the chemiſt. A catalogue of experiments, might be ſwelled to a volume, every one of which would exhibit an intereſting fact, or eſtabliſh ſome law of nature. From exhibiting and explaining the ſublimeſt parts of nature, chemiſtry condeſcends to direct and explain even the culinary art.

Chemiſtry no longer, as in the dark ages, impoſes upon the credulity of the ignorant. It no longer attempts to aſtoniſh the ſimplicity of the vulgar; but is content to explain the ſublime appearances and habitude of matter, upon ſound principles of philoſophy, and to advance the true intereſt of man, by improving the uſeful arts and manufactures.

From the numerous improvements and diſcoveries, which the arts have received, within a few years, from chemiſtry, I ſhall name a few.

It has long been a deſideratum, with chemiſts, to convert that part of our fuel, which is loſt in ſoot, into light and heat. The object has been obtained, by the invention of the thermo-lamp*, by Citizen Leban. By this

* See Med. Repos. vol. V.

apparatus, the hydrogen of the ſmoke is conducted, in a moment, from one apartment to another, where it emits a mild heat, and a bright flame, without leaving either ſoot, aſhes or coals. The diſcovery was made from the analyſis of wood, the reſult of which is one ſixth carbone and five ſixths ſmoke, a great part of which is hydrogen or inflamable air.

Guided by analyſis, the ingenious Clouet has diſcovered a proceſs, for manufacturing ſteel of a ſuperior quality, by a direct compoſition of clay, iron and carbone.

The analyſis of mineral waters has been an object which has long engaged the attention of philoſophers. From the experiments of Mr. Boyle it received its firſt improvements. Within a few years, it has been brought to perfection, by the celebrated Bergman and other German chemiſts; and is now deſervedly ranked among the improvements of analytic ſcience. Theſe medicines of nature may be compounded in places moſt diſtant from thoſe laboratories of nature where they were firſt formed.

By analyſis, wool gives nearly the ſame reſult as oil. Guided by this fact Profeſſor Chaptal has diſcovered a proceſs for manufacturing ſoap, from uſeful articles of woolen, and an alkaline lixivium. No inconvenience has followed from the introduction of this economical proceſs to manufacturies of cloth. There is ſcarce an art or manufacture, which has not, or is not, now receiving improvements from this ſcience.

By the introduction of the oxygenated muriate of potaſh to bleaching, the proceſs has facilitated and ſhortened to a ſurpriſing degree: This diſcovery, the honor

of which has been given to Berthollet, has been already adopted, by the linen manufacturers throughout Great Britain and France.

Seguin has accurately demonſtrated the theory of tanning, and made important improvements in that art, which he has communicated to the public, with a liberality which does honor to himſelf and to ſcience. Painting has received valuable acquiſitions from Mexime. And the art of dying is found to conſiſt in a ſimple principle of affinity. It is no other than a coloring ſubſtance, and a ſubſtance called a mordant, which by its affinity, attaches the color to the cloth.

During the late war in Europe, this ſcience relieved the wants ariſing from ſcarcity. In England, the vegeto-animal ſubſtance or gluten, which reſides in bran, was converted into bread. And in France, ſubſtances, which were not before known to be nutritive, were converted into wholeſome diet.——Such are the improvements, which neceſſarily follow the knowledge of the component parts and principles of affinity of material ſubſtances.

To ſhew the connection of chemiſtry, with all the arts and ſciences, and to ſhew the improvements which have flowed from this connection, would require the numerous volumes, which are conſtantly publiſhed upon the ſubject.

No department of human knowledge, has received ſo great benefit from chemiſtry, as the profeſſion of medicine. From phyſicians chemiſtry had its origin, and for many centuries, was conſidered as a mere appendage of their profeſſion. There is indeed, a connection between chemiſtry and phyſic ; and no phyſician can be a thorough ſcholar in his profeſſion, and be unacquainted with chemiſtry. Reſpecting the acquiſitions of the healing art,

from this ſcience, I ſhall only generally obſerve, that for the preſent improved ſtate of phyſiology and pharmacy, we are indebted to chemiſtry, and that the moſt powerful articles of the materia medica, are creatures of the laboratory*. By the German and French chemiſts, every part of the human body has been ſubjected to accurate analyſis; and the elementary parts and mode of compoſition aſcertained. So many important facts promiſe great improvements to the healing art. Already has chemiſtry, to a good degree, ſwept away the dregs of quackery and ignorance. No longer, do the arts wait the ſlow improvements of blind chance. They are now purſued, upon philoſophical principles. It is probable, that within a few years, many of the neceſſaries and luxuries of life, will be made by a direct compoſition, inſtead of waiting the ſlow proceſs of nature. Indeed, whole animal bodies have been converted into oil, by the abſtraction of their azate.

Chemiſtry has received the addition of a new electrial fluid, the laws of which conſtitute that part of chemiſtry, entitled Galvaniſm. This diſcovery, the honor of which, ought rather to be given to Valta, than to Galvanus, has already been ſucceſsfully applied to the cure of diſeaſes, and promiſes to ſolve ſome parts of nature, which have hitherto eluded the reſearch of philoſophers. To this part of chemiſtry is probably reſerved, to explain the connection, which exiſts between mind and matter.

No part of ſcience, within twenty years, has received ſo great improvements as chemiſtry. The rapid pro-

* Animal Chemiſtry, ſee the 9th and 10th vols. of A. F. Fourcroy's works.

greſs of this ſcience, ſince the adoption of the new ſyſtem, and the preſent competition of its votaries promiſe to carry it, within a few years, to its ultimate point of perfection. Our country may already boaſt, of a long liſt of chemiſts, the number and accuracy of whoſe experiments, are not inferior to thoſe of European chemiſts; and who are ardently engaged in the advancement of this ſcience. Among whom, are Prieſtley, Woodhouſe, Mitchel, Maclean, Paſcalis, and the late Preſident of the Medical Society of Connecticut.

The other part of natural philoſophy, upon which was propoſed to make a few obſervations, is botany; a part of ſcience not leſs pleaſing, though more neglected by our citizens, than any other of the whole circle of the ſciences. This branch of knowledge, is recommended by the example of Solomon, who is recorded to have written of all the plants, from the cedar of Lebanon, to the hyſop upon the wall. The ancients were perhaps as well acquainted, with the virtues of plants, as the moderns; but their diſcoveries are in a great meaſure loſt to us, for want of an accurate ſyſtem of deſcription and claſſification. This defect has been ſupplied, by the labors of Turnfort, Ray, Boerhaave, Linnæus and Miller, who have given to botany, a ſyſtem, which has deſervedly ranked it among the ſciences.

In many parts of ſcience, America is not inferior to the moſt enlightened countries of Europe. The genius and enterpriſe of our citizens are not inferior. Yet however degrading it may be to our national pride, it is a fact undeniable, that we are dependent upon the Europeans, for the knowledge of the plants of our own country. No part of the globe abounds, with ſo great a variety of botanical productions, which from their magnitude, number

and ſurpriſing effects upon the human conſtitution, prove in the vegetable, as the mammoth in the animal kingdom, that nature has not belittled her productions in America.

There are conſtantly imported, into our country, at a great expence, vegetable productions, which grow in wild luxuriance, in almoſt every part of it. The productions of our country may be obtained without the loſs of their eſſential properties by time or adulteration.

Germany, England and France have ſent botaniſts, into our country, to diſcover the treaſures of our foreſts. Theſe botaniſts have carried home ſome of the plants, which are peculiar to this country, and are now publiſhing their virtues* and claſſification.

Botanical gardens were eſtabliſhed in the ſtates of New-York and South-Carolina, by the late king of France. The botaniſt whom he ſent, was the learned Michaux, at preſent a member of the National Inſtitute, and a botanical miſſionary to the ſouth ſeas. The diſcoveries of a ten years reſidence of this philoſopher, which were the laſt year publiſhed in Paris, are truly worthy national attention.—Much good is done in this way, at a very trifling and inſignificant expence. For this compenſation, however ſmall, the botaniſts tranſmits to the country which ſent him, the vegetable productions of all kinds, at once gratifying national curioſity, and enriching his native land, with the uſeful ſpecies of the remoteſt iſlands and provinces of the earth.

While our native citizens have been ignorant or incurious of the treaſures of the foreſts, the induſtrious bo-

* The French botaniſts have publiſhed a courſe of experiments, made with the rhus toxicodendran, a plant peculiar to this country.

taniſts, from foreign countries, diſcover, deſcribe, and teach us how to know them.

Not a ſingle botanical garden has been eſtabliſhed in America, by any authority of our country, either political or academical. We truſt that this reproach, will not long be attached to our country. Even in this State, which has been ſtiled the Athens of America, botany has been moſt neglected. Scarce a naturaliſt is here to be found, who can point out the generic difference of our plants, by their gender and their ſpecific difference, by their foliage and fructification. I know not that a botanical work has been publiſhed, by a native American, ſave that of Profeſſor Bartan, whoſe talents and induſtry promiſe to take from our country, the reproach ariſing from the neglect of this part of ſcience. That part of botany, which treats of the virtues of plants, has been entirely neglected. Already has America produced a bark, which has removed the fatality of that diſeaſe, which in leſs than forty years, deprived Britain of two of her monarchs.* And the properties of a root have been diſcovered by Dr. Archer, which has proved a ſucceſsful remedy againſt a diſeaſe, upon which European authors were either ſilent, or which they confeſſed that they could not cure.

Notwithſtanding the botanical diſcoveries which have been made by Europeans, an unlimited field ſtill lies open for the diſplay of genius and enterprize. Our country every where, abounds with vegetable productions, the properties and deſcription are yet in reſerve, for the diſ-

* James the firſt, and Oliver Cromwell, both died of the intermittent fever.

† See Archer's Treatiſe on the origina trachealis.

covery of the Americans. It is worthy of remark, that many of the philoſophers of our country are turning their attention to this branch of uſeful knowledge.

Why a ſcience ſhould be ſo much neglected the ſtudy of which ſo beautifully exhibits the perfect order and inimitable works of the Deity, in the vegetable kingdom, remains yet to be accounted for. There muſt be powerful reaſons, which have induced our citizens, to be indifferent to the diſcoveries, in natural ſcience; ſtrong reaſons, which have prevented them from ſharing the honor of diſcoveries ſo important.

Among others, the following reaſons have undoubtedly had their influence.

A fondneſs for political preferment, which has pervaded every claſs of ſociety; the deſire of honor, which has been attached to wealth rather than literary attainments, and party politics, which have taken place of every department of ſcience. Party politics, which have inclined our citizens to depend upon intereſt or influence, for honors and emoluments.

I truſt this Society, which on account of its numerous branches is ſo advantageouſly ſituated to excite competion and communicate information, will not be the laſt to patronize chemical and botanical enquiries, or be indifferent to the diſcoveries in the branches of natural ſcience, the inventors of which will perpetuate their names, and receive the gift of fortune, and honors of poſterity.

FINIS.